

Tooth Autotransplantation; Clinical Concepts

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Abstract: *Dental auto transplantation is defined as the movement of one tooth or dental germ from one position to another, within the same person . Tooth reimplantation and transplantation have a long and difficult history, since both procedures have been carried out for centuries, but failed due to healing complications. This article provides an overview concept of auto transplantation and considerations for clinical success.*

Keywords: *Autogenous Autotransplantation, periodontal healing, Tooth, Transplantation*

I. Introduction

Dental auto transplantation or autogenous transplantation is defined as the movement of one tooth from one position to another, within the same person.[1,2] This could involve the transfer of impacted, embedded, or erupted teeth into extraction sites or into surgically prepared sockets.[2] The procedure itself is not a new invention, and the earliest reports of tooth transplantation involve slaves in ancient Egypt who were forced to give their teeth to their pharaohs.[3,4] Eventually, allo transplantation, transplantation of a tooth from one individual to another, was abandoned because of histocompatibility and replaced with auto transplantation.

As there are a lot of reasons for auto transplanting teeth in children, tooth defeat as a result of dental caries is the most common sign, particularly when mandibular first molars are concerned. First molars erupt early and are often a lot restored. Auto transplantation in this situation involves the removal of a third molar which may then be transferred to the site of an unrestorable first molar. Extra circumstances in which transplantation can be careful include tooth agenesis (particularly of premolars and lateral incisors), shocking tooth loss, atopic outbreak of canines, root resorption, large endodontic lesions, cervical root fractures, localized juvenile periodontitis as well as other pathologies. Successful transplantation depends on specific requirements of the patient, the donor tooth, and the recipient site [5]

The history of transplantation of teeth dates back to the 18th and 19th centuries. The earliest reports of tooth transplantation involve slaves in ancient Egypt who were forced to give their teeth to their pharaohs . [6]The distinguished surgeon John Hunter referred to the practice of wrenching a tooth from the jaw of an “indigent and helpless” for a “fine lady” being done for the price of a meal .[7] He also conducted experiments himself in transplantation and reported an incidence of a successful tooth allotransplant in a gentleman in London, in 1772. Stack, in 1883, commented that transplants, replants and repositioning should be done for the poor, who could not afford the artificial dentures. On the battlefield of wars in the past, like the Napoleonic wars, soldiers had to donate their teeth to the officers who had lost theirs in battle . [8]Ambroise Pare indicated that a certain princess had a tooth taken out and it was immediately replaced, supplied by one of her ladies[8].

At present, autotransplantation of teeth has evolved into a viable treatment option for replacing missing teeth, since successfully transplanted teeth have been proved to function as totally normal teeth.[9] Autotransplantation of teeth ensures that alveolar bone volume is maintained, due to physiological stimulation of the periodontal ligament. Moreover, successful tooth transplantation offers improved esthetics, arch form, dentofacial development, mastication, speech and arch integrity .[10] Autotransplants, unlike restorative prosthetic units, also provide proprioception during function and can be used in the growing patient . [11]Finally, the total treatment cost is normally lower in comparison to alternative prosthetic restorative and/or orthodontic treatment options.[5]

The transplanted tooth can serve as a normal tooth when the procedure is successful[5]. Therefore, in addition to improved esthetics and mastication, successful tooth trans-plantation offers arch space maintenance and preserves the volume and morphology of the alveolar bone[1]. The cost is also considerably low in comparison to advanced treatment options such as dental implants and/or prosthetic replacements; moreover, it can be performed as a sin-gle-step surgical procedure. From an orthodontic point of view, the desirable aspect of

autotransplantation is that it allows orthodontic movement[4]. Provided that case selection is carried out meticulously, autotransplantation can serve as a feasible, fast and economical treatment option for patients[5].

A multitude of factors influence the success rate; including developmental stage of the root, type of tooth, surgical trauma, the time tooth is preserved outside of the alveolar bone, the shape/site of the recipient socket, and vascularity of the recipient bed. Last but not least, periodontal ligament (PDL) healing plays an extremely critical role in success[1,7, 9]. Pulp regeneration, however, only occurs in developing teeth[5]. Viability of PDL cells may be affected during extraction or by extra-oral factors such as variable pH, osmotic pressure, and dehydration[2]. There-fore, special attention should be paid to preserving the PDL.[5]

The understanding of the healing process of a transplanted tooth is imperative to its success. In other words, it minimises the incidence of root resorption and tooth ankyrotic complications. The preservation of favourable periodontal ligament (PDL) on the donor tooth is the critical factor for success. Reattachment occurs in about 2 weeks after autotransplantation between the PDL connective tissues of the donor root surface and the wall of recipient socket. The type of healing of transplanted tooth is dependent on the surface area of the damaged root to be repopulated. When the damaged PDL surface is small, the healing can be achieved by cemental healing. However when the damaged PDL surface is large, some of the root surface will be resorbed followed by apposition of bone rather than dentine, thus root resorption will ensure.[12] Genetically, PDL cells can differentiate into fibroblasts, cementoblasts and osteoblasts. In the ideal situation, one would hope PDL cells on the root surface to differentiate into cementoblasts and induce dentine formation, whereas PDL cells on the side of bony socket wall surface to differentiate into osteoblasts thus inducing bone formation. In addition, the contributions of the progenitors PDL cells on the recipient fresh extraction sockets should not be overlooked, that also accounts for the higher successful rate for freshly extracted recipient sockets compared to artificially drilled ones. It is important to minimise inflammation so that reattachment can progress to the healing stage with the proper differentiation of the PDL cells. Inflammation will be minimised when the transplanted tooth is sealed with tight suturing of the gingival cuff around the tooth to prevent ingress of infective agents. This can be achieved by trimming and suturing of the recipient site flap before the implantation of the donor tooth. When the follicle or even dentigerous cyst is present over the amelo-dentinal junction of the donor tooth, it is also useful to preserve the soft tissue lining around the tooth to facilitate suturing to the recipient gingival cuff. It is also important to minimise inflammatory pulpal response from the transplanted tooth. For fully developed donor teeth, root canal treatment should be initiated 2 weeks after transplantation. The interim period of 2 weeks is chosen to minimise trauma to the PDL in the initial reattachment healing phase, yet further delay will increase the chance of complication of inflammatory resorption secondary to pulpal infection.[12,13] There are numerous indications for autotransplantation of teeth including among others impacted or ectopic teeth, premature and/or traumatic tooth loss, loss of teeth because of tumours or on iatrogenic grounds, congenitally missing teeth in one arch with clinical signs of tooth crowding on the opposing arch, replacement of teeth with bad prognosis and/or developmental dental anomalies.[13,14]

Autotransplantation may provide a simplified and faster treatment option for patients with impacted or ectopic teeth. This is specifically the case for adults who often reject the idea of a long-term orthodontic appliance therapy, in order to align an ectopic tooth, yet would benefit greatly from positioning this tooth in the dental arch .[14] It is also indicated in cases where the ectopic tooth's position is such that it is impossible or too risky to move into a proper position in the arch, by using solely orthodontic means. In these cases, autotransplantation could constitute a safer, alternative treatment option .[15,16]

Autotransplantation may also be very useful in cases of traumatic tooth loss. Maxillary incisors are the teeth most frequently involved in accidental incident .[17] There are several reports in which mainly premolars were used as replacements of prematurely lost upper incisors in crowded dentitions. In these cases, autotransplantation produces offer, with the help of restorative dentistry, an aesthetic result, maintaining at the same time the alveolar bone volume/[18]

In cases of congenital absence of permanent teeth, replacement with autotransplanted teeth guarantees that the alveolus will not atrophy, especially when the patient is still at a growing age. Successful tooth transplantation in young individuals also facilitates dentofacial development, mastication and speech, along with maintenance of the attached gingivae, in a natural shape and level .[19] Even in the case of failure after a certain number of years, the maintenance of alveolar bone volume until then is essential. This is especially the case when a dental implant has been chosen as an alternative restorative solution.[20] In theory, the donor tooth should preferably be of limited value in the dentition. Anyhow, the teeth most commonly used are premolars, canines, incisors and third molars. Premolars are particularly suitable transplants for the upper incisor region, because of their favourable morphology, size and single root canal. However, it may be necessary to rotate them, in order to increase the mesiodistal dimension. Subsequently, these teeth are modified to simulate incisor teeth with restorative techniques. The palatal cusp may also require enamel reduction to prevent occlusal

interferences. A supernumerary incisor can also become a donor tooth in the anterior arch segment when required .[14] Contraindications include cardiac anomalies, poor oral hygiene poor self-motivation and insufficient width of the alveolar bone. If the recipient site has insufficient buccopalatal or buccolingual width to accommodate the donor tooth, resorption of the alveolar ridge may occur.[5,13] If transplantation is deferred, it should be scheduled as soon as possible within 2 months so that the resorption of bone that occurs in the interim does not compromise the wound bed for the donor tooth.[5,13] Successful tooth transplantation offers improved esthetics, arch form, dentofacial development, mastication, speech, and arch integrity. [21,22,23] The autotransplanted natural tooth has the capacity for functional adaptation and preservation of the alveolar ridge, which is advantageous when compared to a prosthesis or an osseointegrated implants that are stationary and do not erupt to compensate for further growth. This is an important consideration when dealing with missing teeth, whether congenital or acquired, in orthodontics of young patient.[23,24,25] Tooth autotransplantation however eliminates histocompatibility issues and is successfully used with varying success. Our current understanding of periodontal healing has improved success rates and clinicians interest in the procedure. This article provides an overview concept of autotransplantation and considerations for clinical success.

II. Patient Selection

The sequence of autotransplantation of teeth includes clinical and radiographic examination, diagnosis, treatment planning, surgical procedure, endodontic treatment, orthodontic treatment, restorative treatment, and follow up.[25] Cases are examined and diagnosed mainly with clinical and radiographic information about whether or not transplantation is indicated. Important information includes anatomic shape of the donor teeth and how they match with recipient sites, stage of root development, case of preparation of the recipient socket and potential for damage of the donor tooth at removal.[5,21,25] The use of dental magnetic resonance imaging with administration of contrast material for the postoperative assessment of the pulp perfusion of transplanted teeth has also been reported .[26] In addition, a non-invasive, objective and painless method, such as laser flowmetry is also available to ascertain revascularization and monitoring of pulpal response of the transplanted teeth .[27] imaging techniques have also been used, such as 3D-volume tomography, for the evaluation of the periodontal space of the recipient alveolar socket and dental Cone Beam Computed Tomography for the production of replica-teeth and surgical guides, using stereolithographic CAD/CAM systems . [28,29]The combination of spiral CT imaging and computer- aided prototyping to produce surgical templates for the procedure has been proved to be very useful for the avoidance of injuries of the delicate donor teeth . The increased availability of CBCT and the reduced dose of the radiation produced in comparison to spiral CT should result in a more broad application of the method described.[30]

A key to success in autotransplantation are;

2.1.General factors:-

Meticulous Case Selection is a key to success in autotransplantation. Some of the general factors to consider are:

- a) Patient should be in good general health.
- b) Patient should have good oral hygiene.
- c) Patient should be willing to be present for regular timely follow up.
- d) Patient should understand, appreciate and follow all instructions.
- e) Patient cooperation and compliance are indispensable for a predictable clinical outcome.[3,13,14,15]

2.2.Local factors:-

- a) The recipient area receiving the transplant should be healthy with adequate alveolar bone support.
- b) Should be free of any infection or chronic inflammation.
- c) Donor tooth should be extracted atraumatically, hence abnormal root morphology is a contraindication for transplantation.
- d) Teeth with closed or open apices may be transplanted. [3,13,14,15]

Teeth with Closed apices:-

A tooth with complete root formation requires Root canal treatment after transplantation. Root canal treatment is usually done after transplantation and may be completed before removal of the splint.[21,22]

Teeth with Open apices:-

The most predictable clinical outcomes is achieved when teeth between half and two third root completion are transplanted. These teeth remain vital ensuring root end closure physiologically with no need for endodontic treatment.

These are some of the clinical situations in which autotransplantation can be considered.[23,24,25]

a) Tooth loss secondary to dental caries: The first molars are the most common permanent tooth lost due to caries and periodontal diseases. The third molars may be considered for the replacement of this tooth.[5]

b) Tooth Agnesis: The third molars followed by mandibular second premolars are the teeth most commonly involved. The condition may be associated with certain malocclusions. Age, occlusion, space requirements of the patient as well as the size and shape have to be carefully evaluated for the formulation of the treatment plan.[35,36]

c) Traumatic tooth loss: Children are more prone to injuries in the anterior dentition. Trauma is more frequently observed in males, in those with Class II malocclusion and in the age group of 8-10 years.[5,13]

d) Atopic eruption of canines: The routine management of ectopically positioned canines is surgical exposure followed by orthodontic extrusion. Auto transplantation may provide reliable, fast and simplified treatment, atleast in some of these cases.

e) Teeth with poor prognosis (large endodontic lesions, localized severe periodontitis³² and cervical root fractures[5,13,14]

f) Cleft lip and palate patients: Tooth transplantation is preferred for the replacement of teeth in cleft lip and palate patients as it induces alveolar growth potential especially during adolescence. This is a viable alternative to other treatments because of predictable clinical outcomes. [5,15]

III. Surgical Technique

Pre-operative administration of antibiotics is recommended a few hours before surgery. Following disinfection and anesthesia of the surgical sites extraction of tooth at the recipient site is advised. In case of immediate transplantation, the tooth to be extracted in the recipient site should be extracted before the donor tooth. Before preparing the recipient socket, the donor tooth should be extracted and examined for anatomical form, size and PDL condition. Care must be taken not to damage the PDL. An intra-crevicular incision is made before luxation to preserve as much PDL on the root as possible and the donor is extracted slowly and as atraumatically as possible. The donor tooth should be placed back in its original socket after it is removed and waiting to be placed in the donor socket. If any extra-oral time is anticipated, the tooth should be stored in a storage medium like Hank's balanced salt solution that will maintain the viability of the periodontal ligament cells.[5]

The mesiodistal width of the root and crown and the length of the root of the donor are measured. The recipient socket is prepared a little larger than the donor using surgical round bars at low speed and cooling with saline. Attempting to place the tooth into the socket with light pressure periodically checks the match between the recipient and the donor sites. Obstacles in the socket wall are removed as encountered.[5,13] The optimal placement of the donor to the recipient is to establish the biologic width similar to that of a naturally erupted tooth. Deep placement to a position below the occlusal level of adjacent teeth should be avoided, if possible, so that orthodontic treatment will not be needed at a later stage.[14,15] The most critical procedure in surgery is tight closure of the gingival flap around the donor tooth. This optimizes reattachment and, importantly, may block bacterial invasion into the blood clot between the tooth and socket. In order to achieve this close adaptation around the donor tooth, trimming of flap is needed in some cases, and suturing of flap before the donor is positioned into the socket is recommended in every case. [5]Splinting by means of sutures is then performed. If the transplant. is not stable after suture splinting or if much more occlusal adjustment is necessary, splinting is changed to one with wire and adhesive resin. If the transplant is not stable but no occlusal adjustment is needed, splinting with wire and resin can be delayed for 2 or 3 days after suture splinting because the former is time consuming and bleeding during the surgical procedure makes optimal results difficult.[22,23] The occlusion must be checked to ensure that no occlusal interference is present. If a suture is used for stabilization, ideally the occlusal contact should be reduced extra-orally prior to positioning of the donor, taking care not to damage the PDL. It could also be performed intraorally before the extraction of the donor. If a wire splint is used, occlusal adjustment can be done after placing the splint.[5,24] Occlusal adjustment should be conservative, since a composite restoration will be needed after healing to adjust the occlusion and/or esthetic

appearance of the crown of the tooth. A radiograph is taken preoperatively, before and after splinting to evaluate the position of the donor tooth in the new socket. Surgical dressing (periodontal packing) is applied to protect the transplant against infection during the first 2–3 days in the wound healing. This dressing is removed at about 3–4 days post surgery. The sutures are removed 4–5 days after the surgery.[25]

In some cases auto transplantation may not be possible as a one-stage procedure. Two-stage transplantation has been reported in which an ectopic canine was removed and initially stored in the buccal pouch whilst the recipient site was orthodontically reopened.[25] The potential problem of resorption of the trans-planted tooth is minimized if contact between the tooth and periosteum is avoided during storage. In some situations, there may be resorption of the alveolar ridge at the recipient site with insufficient bucco- palatal width to accommodate the transplant.[25] In such cases, specialized investigative techniques may need to be carried out to ascertain the amount of bone present bucco-palately. Alveolar bone grafting of the recipient site may be required prior to transplantation.[5,25]

IV. Post-Operative

patient with appropriate post-operative care through such measures as oral hygiene and dietary instructions, especially for the first post-operative week. Then a recall is set usually after 7-10 days, for the removal of the sutures.[37]

A radiographic post-operative evaluation is used in order to assess the condition of the donor tooth and the relevant periodontal tissues. The use of CBCT for postoperative monitoring of the autotransplanted teeth has been also advocated recently. This kind of imaging provides a much better evaluation of the periodontal ligament and allows a detailed assessment of the root surface.[28]

Reasons for Failure: The causes of failure of the autotransplant is chronic root resorption, inflammatory resorption, replacement resorption i.e., ankylosis, marginal periodontitis, apical periodontitis, caries, and trauma. Inflammatory resorption may become evident after 3 or 4 weeks, while replacement resorption may not become evident until 3 or 4 months after transplantation. [5,23,25]

Precautions for Failure: The incidence of both types of resorption can be decreased with atraumatic extraction of the donor tooth and immediate transfer to the recipient site to minimize the risk of injury to the periodontal ligament. [5,23,25]

V. Success Criteria

Success rates are found to be 90% or higher. In a recent study, Sugai followed 114 transplants and found a one- year success rate of 96%, with 84% at five years.[9] Other studies have shown between 79 and 95% success rates, with follow-up times as long as 41 years. [9] Another recent study, by Bae, showed that high success rates (84%) can even be achieved with closed apex teeth and root canal treatment.[38] These consistently high success rates are a contrast to the variable results reported in many older studies. Schwartz and others yielded success rates of only 76.2% at 5 years and 59.6% at 10 years.23 similarly; Pogrel found that his success rate for 416 auto transplanted teeth was 72%. [39,40] A case of autotransplantation may be called a success if it is associated with normal healing without inflammatory resorption, the tooth is firm with no pain on mastication. However there are certain radiographic and clinical criteria to determine success.[15] Radiographically a case may be deemed successful when healing occurs with a normal lamina dura[32,34] with no evidence of root resorption. It is pertinent to note here that minimal inflammatory or replacement resorption may not be apparent on the radiograph25 immediately. It takes up to 3-4 months12 or even 1 year27 after the procedure to be detected. Inflammatory resorption on the other hand is evident in about 3-4 weeks [8,27]

In case of teeth with immature apex being transplanted, normal physiologic root development must be observed. Normal tooth mobility, healing without inflammation, no marginal attachment loss and a healthy pulp indicates a successful transplant clinically.[12]

The success rates are highest when donor teeth are premolars, with half to two third root formation transplanted with minimal trauma and extra oral dry time. Therefore we can conclude that the procedure is technique sensitive.[5,25]

5.1. The Development of the Root: Transplanted teeth with incomplete root formation have a 96% rate of pulpal healing, compared with 15% for transplanted teeth with complete root formation.10 Most authors believe that the roots should be developed beyond their bifurcation for successful transplantation of the tooth.

Some authors prefer radiographic evidence that the root has developed at least 2 to 3 mm, whereas others advocate root development of at least 3 to 5 mm.[13,14] Still others stipulate root development between one-third to three-quarters of its final length.[13] Although higher success rates are achieved with teeth that have immature roots, these teeth have less root growth after transplantation than other autografted teeth that have more mature, although not completely formed, apices.[8] The diameter of the apical foramen is a reliable predictor of pulpal healing. Teeth with an apical diameter greater than 1 mm have a diminished risk of necrosis because postoperative revascularization is more likely. Overall, transplantation of teeth with immature roots offers high success rates because root development of the donor tooth and adjacent alveolar bone growth are unimpeded.[15] The success rate of autotransplantation of teeth with complete root formation is questionable. The American Association of Endodontists recommends that the pulp of teeth with closed apices be extirpated 7 to 14 days after transplantation; otherwise the necrotic pulp and subsequent infection may result in inflammatory resorption and decrease the survival time of the autografts.[2] Moreover, all postoperative treatment should be done within 8 weeks.[14] Endodontic treatment or apicoectomy during the surgical procedure is not advisable because it increases the risk of root resorption.[5]

5.2. Atraumatic Procedure: An atraumatic surgical technique preserves bone and periodontal support. Minimal handling of the transplant is required to protect the Hertwig's root sheath and pulpal tissue; otherwise root growth may be compromised, leading to ankylosis or root resorption and attachment loss.[8] The tooth to be transplanted should be out of its socket a minimal amount of time to avoid desiccation. The longer the tooth is left outside the socket, the poorer the prognosis. [41] A 5 year follow up study by Vrien showed that despite damage to the follicle of the upper third molar during surgical transplantation shows a good result.[13,25]

5.3. Adequate Fixation: Excessive time or rigid splinting of the transplanted tooth will adversely affect its healing outcome. The splint should not force the tooth against the bony walls of the alveolus because it may damage the periodontium.[16] Most reports advise flexible splinting for 7 to 10 days, with sutures placed through the mucosa and over the occlusal surface of the crown because this permits some functional movement of the transplant and stimulates periodontal ligament cellular activity and bone repair. Splints can also compromise oral hygiene procedures, thus leading to periodontal inflammation around the transplanted tooth. The transplanted tooth must be placed at the same occlusal level as the donor site so that it will develop a longer root than those placed in a superficial, more occlusal, position. However, if the graft has a mature root and is fully erupted, the graft should be placed just slightly below the occlusal level to prevent postoperative trauma.[5,8,21,23,25]

Periodontal Healing: Preservation of the periodontium of the grafted tooth is key to a successful clinical outcome. When the periodontal fibers are vital, natural reorganization of the periodontal fibers occurs. Periodontal healing is usually completed after 7-8 weeks and can be diagnosed radiographically as a continuous space around the root with absence of root resorption and presence of a lamina dura. The final position of the donor tooth within the recipient socket influences periodontal healing. The donor tooth should be placed so that 1 to 2 mm of the width of the periodontal ligament stays above the bone crest to achieve an ideal biologic width. Apical migration of epithelium may occur and result in vertical bone resorption due to deep placement or long connective tissue attachment due to too shallow placement.[13,14,15]

VI. Dental implant and autotransplantation of teeth

Autotransplantation is now a common procedure in dental practice especially in children and adolescents. It's considered as a viable alternative to conventional prosthetic and implants rehabilitation from both therapeutic and economic standpoints. [41] Although its long-term prognosis is not predictable, autogenous transplantation of teeth with both complete and incomplete root formation appears to be a sound treatment option for replacement of a lost or hopeless tooth, usually providing satisfactory clinical, aesthetic and functional outcomes. In addition, autotransplanted teeth can preserve the amount and quality of alveolar bone, thus permitting later insertion of a metallic implant, if this should be necessary. [42] Jonsson & Sigurdsson demonstrated the long-term outcome of 40 consecutive patients having transplanted premolars. The transplants were removed from maxillary second premolar positions in 35 of 40 patients. This is not unexpected because orthodontic treatment planning commonly includes extractions in the maxillary arch to reduce arch length or relieve crowding. After initial healing periods, 35 of 40 (87.5%) of the transplanted teeth were orthodontically

moved. The possibility of orthodontically reposition the transplant makes this procedure of specific interest when compared with dental I

mplants. Another advantage of autotransplants, compared with dental implants, is the possible avoidance of space maintainers when orthodontic treatment is finished in young patients and implant placement scheduled later.[43] Transplantation has a key role in the replacement of young patient's missing teeth . At this age, the alveolar bone is not yet complete thus becoming a difficult problem to solve in the future treatment .[17] Despite the increasing use of osseointegrated implants in patients with missing teeth, their use is contraindicated in growing patients. If implants are placed in patients with residual facial growth, infra-occlusion of the implant occurs as the implant becomes ankylosed to the bone . Subsequent alveolar bone growth produces a poor esthetic result.[34] The potential for using autogenous transplanted teeth in children thus requires further consideration.[13]

It is inevitable to compare transplants with implants because the two techniques have similar purposes. So, the criteria for choosing each must be discussed. Implants are indicated to all patients (who can afford them) while transplants are limited to those who have appropriate donor teeth³⁶. The techniques for transplants and implants are similar in difficulty and so is the high prognosis. However, the post-surgical restorative options are generally much simpler for transplanted teeth.[5,25,34,36]

Studies shows, transplants would be chosen prior to implants in the following cases:

- Patients treated before pubertal growth: If osseointegrated implants are placed in these patients, they do not erupt along with adjacent teeth and result in infraocclusion with functional and esthetic problems. [5,25,34,36]

Transplanted teeth erupt in harmony with the adjacent teeth. However, it should be emphasized that transplantation should not be carried out too early, since at this stage of root development, the prognosis is not as predictable. [34,36]

- When intra-alveolar transplantation or intentional replantation is indicated: Severely decayed teeth and crown-root fractured teeth can often be saved by surgical Extrusion . In addition, intentional replantation is a treatment option for teeth with endodontic disease that cannot be treated by conventional means. In clinical practice, it usually makes sense to maintain the use of natural teeth for as long as possible. With such procedures available, extractions can be avoided or at least delayed[36].

- When patients have an unrestorable tooth requiring extraction and an ideal donor tooth is present: Transplants have several advantages over implants in terms of function, esthetics, time and cost. Immediate transplantation with extraction at the recipient site is a procedure that provides significant time saving compared to implants. Healing is rapid and function is obtained almost immediately. The transplanted tooth has osteoinducing properties that results in bone regeneration of the bony defects around transplants without graft materials, significantly reducing time and cost compared to implants. Transplants have the potential for superior esthetic results, since the natural emergence profile and the natural beauty of enamel and crown form is maintained. Usually, the total cost of transplantation is much lower than implant treatment. [5,25,34,36]

VII. Concepts

The main purpose of this specific technique is to substitute a tooth, that has been lost or that has indication for extraction, because of a bad prognosis, by another tooth that presents more advantages for being in the receptor area, and/or that has no function in its primary location.[12,13,36]

It can be considered, in a wider concept of tooth autotransplantation for some authors such as Tsukiboshi, distinct situations: First, when a tooth is extracted from a location and reimplanted in a different one, which is named tooth transplantation; Second, when a tooth is repositioned in its own alveolus, as in verticalization of 3rd molars or surgical extrusion of a tooth; Third, and finally, when an extracted or avulsed tooth is treated and reimplanted in its own location sometimes as an alternative to periapical surgery.[13] This is a more global concept including intra-alveolar transplantation and intentional reimplantation, because all are characterized by a similar healing process.[22,25]

Autotransplantation of teeth are an alternative as any other and should be considered when planning a treatment. This technique can give some advantages, such as a possibility for a fixed bridge (where before it would only be possible to place a dental implant or removable prothodontics), the reposition of teeth without orthodontics, the use in helping to solve agenesis problems and the surgical extrusion of fractured teeth (to allow dentistry/ fixed crowns). [33]

This technique usually requires one surgery. Besides all this advantages, one of the biggest is the fact that the patient regains a proprioceptive feeling in the transplanted tooth, with normal periodontal healing, allowing a natural feel during chewing[44]. But the main advantage is the use in children and adolescents, because of its

continuous induction on the alveolar bone, and therefore allowing for the normal physiological alveolar growth.[44,45] It also presents some disadvantages, such as being less predictable when using teeth with complete root development, the possibility of pulpar necrosis, and the need for endodontic treatment, very frequently. It also demands a strong collaboration and motivation from the patient. If this does not happen, the success rate falls abruptly.

VIII. Conclusion

Tooth autotransplantation is a demanding surgical procedure. The dentist can reduce the possibility of complications and increase the success rate by applying a methodology based on the modern guidelines about tooth auto-transplantation. This will ensure that the transplanted teeth will remain for a significant period of time functional, offering another possible treatment plan with various advantages for his patient oral health.

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